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THE STRAWBERRY AND ITS CULTIVATION IN CANADA

BY

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DIVISION OF HORTICULTURE

DOMINION EXPERIMENTAL FARMS

WITH

A SECTION ON COMMON STRAWBERRY INSECTS AND
THEIR CONTROL

BY

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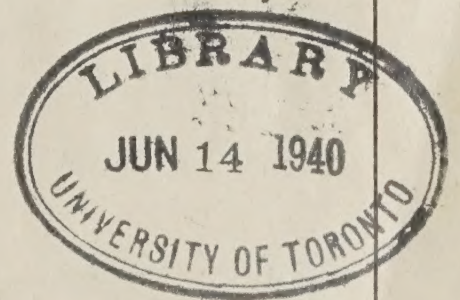
A SECTION ON COMMON STRAWBERRY DISEASES AND
THEIR CONTROL

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THE STRAWBERRY AND ITS CULTIVATION

The strawberry is the most important of the small fruits of Canada. The latest census returns show production and value by provinces which indicate the widespread distribution of this cultivated fruit from coast to coast. This wide range of adaptability not only makes the strawberry popular from a commercial standpoint but also renders it especially desirable for the home garden in those parts of Canada where it is difficult to grow many edible fruits.

The strawberry is found wild in Canada from the Atlantic to the Pacific ocean, and from the southern boundary as far north as the 64th parallel. Large quantities of the wild fruits are gathered. The cultivated varieties are grown successfully in almost every district where the wild ones are found, but in some areas they require protection or irrigation. The season for ripe fruit begins early in June in southern Ontario and in parts of British Columbia. At Ottawa the first ripe fruit has been obtained on June 15, and the last picking of the latest variety has been on July 21 for the varieties which usually bear only one crop in the season, but fruit is obtained from the everbearing sorts until late in October, unless frosts are severe. The season in the more southern parts of the province of Quebec is somewhat similar to that at Ottawa, except along the lower St. Lawrence, where it is much later, the fruit not being ripe until about the first week of July, and the season continuing until the second week of August. The season in Nova Scotia and Prince Edward Island extends into August also. In some parts of the Prairie Provinces as well, the season is not over until August. The later the spring and the cooler the summer, the later the strawberry ripens, as a rule.

With improved transportation methods the distance of shipping this fruit has greatly increased, until to-day it is not uncommon for carloads to be marketed several thousands of miles from their source of production. This places fresh strawberries on our markets over a very much longer period than would otherwise be the case and no doubt has much to do with keeping down the price during the early part of the local season. Nevertheless the local product always brings at the outset a somewhat higher price than the tail-end of the foreign product, principally because it reaches the consumer in better condition.

TOTAL COMMERCIAL PRODUCTION OF STRAWBERRIES AND VALUE BY PROVINCES
FOR 1934, 1935, 1936

	1934	1935	1936
Nova Scotia.....Qts.	325,000	976,000	1,100,000
\$	39,000	107,360	99,000
New Brunswick.....Qts.	1,000,000	1,100,000	1,700,000
\$	90,000	99,000	102,000
Quebec.....Qts.	5,890,000	6,160,000	7,671,000
\$	530,000	524,000	690,000
Ontario.....Qts.	6,753,700	11,819,000	6,168,000
\$	878,000	827,300	524,300
British Columbia.....Qts.	6,274,100	7,450,400	4,908,000
\$	431,100	794,300	531,700

The largest proportion of the Canadian production is consumed in Canada. Nevertheless, more recent statistics show that Canada's export in strawberries is steadily increasing. The export in 1934 was 177,868 pounds with a total value of \$20,337; in 1935, 1,839,693 pounds valued at \$149,937; and in 1936, 1,144,448 pounds at a value of \$90,771. The marked increase in 1935 was due to a heavy demand for processed berries, from the United Kingdom. The following countries imported strawberries from Canada in 1934, 1935 and 1936: United Kingdom, United States, Alaska, British Straits Settlements, China, Hongkong, Newfoundland, and St. Pierre and Miquelon.

MONTHLY IMPORTS OF STRAWBERRIES ENTERED FOR CONSUMPTION IN CANADA,
1934, 1935 AND 1936

	1936		1935		1934	
	lb.	\$	lb.	\$	lb.	\$
January.....	6,160	1,327	3,389	869	28,232	5,019
February.....	13,528	2,688	166,420	19,168	115,305	11,871
March.....	125,376	17,140	138,311	22,654	246,197	27,771
April.....	574,051	57,976	568,714	53,868	572,161	52,819
May.....	2,211,884	187,276	2,437,653	181,664	3,777,657	208,365
June.....	1,521,309	132,121	1,833,869	133,729	1,326,474	111,732
July.....	18,358	1,387	2,039	228	480	316
August.....	302	49	129	40	.....	.....
September.....	.....	.....	50	8	210	10
October.....	.....	.....	61	10	160	36
November.....	.....	.....	60	12	695	157
December.....	821	221	792	298	187	54

LOCATION AND SOILS

The prospective strawberry grower if he has not already located, should bear in mind a few important details which may have a considerable bearing on the success of his undertaking. Proximity to a market or some good shipping point is a very important factor. Very frequently growers located near a really good market net greater returns per acre than those who though located in far better fruit areas, are either farther from their market or are catering to a market too well supplied with this fruit. There are still excellent opportunities for the establishment of strawberry plantations close to some of the larger cities and towns which are at present largely dependent for their fruit supply upon distant sources. This closeness to an excellent market goes a long way towards making up for other deficiencies such as possible winter injury, lower yields due to weather conditions, etc.

The possibility of being able to obtain pickers is another important factor which will have an influence on the area to be planted. With the advent of motor transportation this is easier of solution than formerly, for it is now possible to gather up the pickers from a nearby city or town and in a few minutes transport them to the fields where they may remain for the day to be returned in the evening by motor truck.

The actual location of the plantation, however, depends upon factors governing the economical production of the crop. Among the most important of these is to select a situation where good drainage is obtainable. It is not sufficient that underdrainage be present, good surface drainage is absolutely necessary for assured success. The strawberry will not stand being covered with water in early spring or during the late winter. Unless there is sufficient slope to the land this is difficult to overcome in some years, when the ground is frozen for a time after the early spring melting of snow, thus rendering the underdrains of little use for a short period.

Low-lying pockets are also to be avoided especially in districts where late spring frosts may be expected. A gentle hillside or slope permits of better air drainage and often eliminates this trouble entirely.

SOILS

The strawberry will thrive on a great variety of soils, from a very light sand to a heavy clay, but when it is possible to make a selection, a moderately light friable soil is much to be preferred. From the standpoint of the physical texture a light sand is satisfactory, but being generally deficient in humus and plant food it is not as valuable as a heavier sandy loam or a very light clay loam.

As it is important to get the young runner-plants rooted as early as possible, a soil which does not pack or bake is much more suited to strawberries than a stiffer but possibly naturally richer soil. If a stiff clay is used, constant cultivation and care during the first year is very important.

Soil Moisture.—There is considerable variation in locations with reference to their moisture content during a dry season. This is frequently dependent upon the depth of the soil and also upon its physical texture. This is an important consideration where dry spells are frequent during the strawberry-picking season. At the Central Experimental Farm, the soil is a very light sandy loam and, while rather exacting in its fertilizer requirements, has a desirable physical texture rendering it easily worked. On account of its great depth this soil is very retentive of moisture and, although often dry on the top inch, shows plenty of moisture below. A heavier textured but richer soil would probably not be as retentive of moisture.

Cultivated Land.—Land which has been in sod for some years should be avoided until a few hoed crops have been grown on it. Such land is liable to be heavily infested with white grub, which causes material damage to a newly set plantation. This pest is not so prevalent on land which has been cultivated for a few years.

PREPARATION OF THE SOIL

As stated in the previous paragraph, land under cultivation is preferred for a new strawberry plantation. Another exceedingly important factor is control of weeds, especially if the plantation is to be kept for more than one year's fruitings. It is advisable to avoid, therefore, land which is infested with couch grass, or other persistent weeds difficult to control.

A thorough ploughing, disking, harrowing and rolling is necessary before planting. Fall ploughing on certain soils is to be preferred, followed with a thorough pulverization and a levelling and smoothing by a spring-tooth harrow. For ease in planting, rolling is generally recommended previous to the field being marked out.

FERTILIZERS

The fertilization of the land for a successful strawberry crop is dependent upon a number of factors. As the crop occupies the land for at least two seasons, it is rather exacting in its requirement of humus, which is essential for the proper retention of moisture and the liberation of plant-food. As humus can only be supplied by green manure crops or by manure, the quantity to be supplied before the plantation is set out will depend upon the nature of the soil and the length of time the plantation is to be fruited.

On very light sands large quantities of humus will need to be supplied; on loamier soils humus is not such a vital consideration. If only one crop is to be taken from the plantation, a smaller amount of humus will be required than where two or more crops are to be removed.

As manure, in addition to its humus content, contains large quantities of nitrogen, phosphoric acid, and potash, it makes probably the best fertilizer that

can be supplied, although it may be necessary to supplement it with some form of commercial fertilizer. Failing an abundant supply of manure, a rotation which will permit of the ploughing under of a crop of green manure, such as one of the clovers or some other good legume, will supply not only humus but also a quantity of nitrogen.

It is thus quite possible by the use of green manure crops and fertilizers to maintain both the humus content and the plant food of the soil. This is of particular advantage to growers of small fruit who are finding it increasingly difficult to procure manure. When green manure crops are grown the land is not producing a cash crop. The cheaper the land employed, the more economical this method becomes.

Any additional nitrogen required may be applied as nitrate of soda, or ammonium sulphate; phosphoric acid as acid phosphate or as bone meal; and potash as muriate or sulphate of potash.

ROLE OF NITROGEN IN STRAWBERRY CULTURE

Nitrogen is the most unstable of the plant food elements and is more often deficient in the soil than other elements; consequently beneficial results are very frequently observed from nitrogen applications. In order to determine the effect of nitrogen at different seasons of the year a series of experiments was inaugurated at the Central Experimental Farm, the results of which are given below.

There are at least three ways in which applications of a nitrogenous fertilizer may affect the yield of strawberries: (1) by causing an actual increase in the number of flowers or fruit buds formed; (2) by causing an increase in the size of the individual fruits; and (3) by increasing the set of the bloom.

(1) This is probably the most important. In the annual report of the Horticultural Division for the year 1921, evidence was presented to show the value of early formed runners in the plantation. The following table taken from that report shows clearly the comparative value of early and late formed stolons or runners as fruit producers. The early formation of runners is dependent upon an available supply of plant food, including nitrogen, in the early part of the planting year. The presence of nitrogen therefore affects the number of fruits formed by encouraging the early formation of runner-plants during the first year of the plantation.

TABLE SHOWING THE PERCENTAGE OF STOLONS FORMED ON DIFFERENT DATES

Date	Percentage	
July 7..	0.37	} 6.76 per cent formed during month of July produced 6.5 per cent of the fruit.
" 14..	1.11	
" 16..	0.61	
" 18..	0.74	
" 21..	0.25	
" 23..	1.23	
" 25..	0.61	
" 26.. . . . .	.12
" 28..	1.11	
" 30..	0.61	
Aug. 22..	0.98	} 25.10 per cent formed during month of August produced 34 per cent of the fruit.
" 6..	1.11	
" 8..	0.25	
" 11..	2.21	
" 14..	1.11	
" 18..	3.08	
" 22..	16.36	} 31.36 per cent formed during month of September produced 39 per cent of the fruit.
Sept. 3..	7.13	
" 8..	0.49	
" 18..	16.61	
" 19..	0.12	
" 20..	0.71	} 39.22 per cent formed during the month of October produced 19.6 per cent of the fruit.
Oct. 10..	27.43	
After Oct. 10..	11.79	

Dealing first with that part of the experiment where stolons were permitted to remain in their original position, it was found that there was decided correlation between the date the stolon rooted and the ultimate number of fruits it produced. Stolons formed as late as October 20 produced, on the average, only five fruits, whereas stolons formed about the middle of August produced an average of sixteen fruits. This is portrayed graphically in figure 1. Runners formed much earlier than this produced about nine to ten fruits. Apparently the reason for the falling off of these extremely early formed stolons is that they are the parents of large numbers of stolons and, like the original parents, become depleted of energy. The number of these early, poor yielders is comparatively small, as will be seen by examining the preceding table which shows the percentage of stolons formed on the different dates. From an examination of this table and the figure, it is evident that the most profitable period of stolon formation lies between the latter part of July and the last of September. Although over one-third of the stolons were formed in October they produced only 19.6 per cent of the crop, which, when compared with 34 per cent of the crop produced by 25 per cent of the stolons which were formed in August, demonstrates the great value of early planting and good care in the early part of the season.

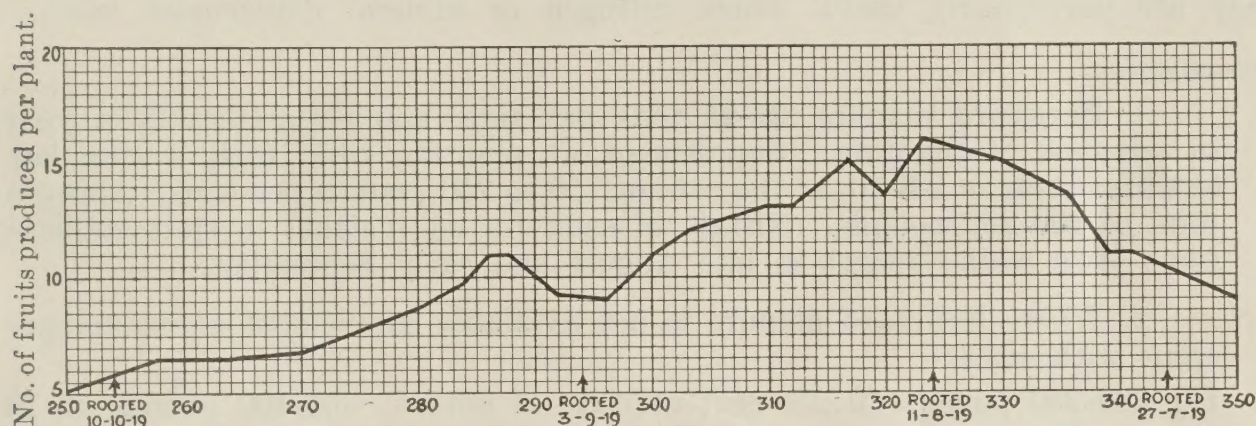


FIG. 1.—Showing relation between yield and age of the stolon. Age of the plants in days, dating from time of formation to July 1, 1920.

Further work with nitrogen applications has shown that when a heavy application of manure is applied the year previous to planting and the land used for a hoed crop, there is in a good average soil a sufficient supply of nitrogen and other plant food to encourage maximum runner formation in the early part of the season. This same series of experiments demonstrated, however, that even though there appeared to be a sufficient supply of nitrogen to promote maximum vegetative extension or runner formation, an application of nitrogen made in September of the planting year caused a very appreciable increase in yield. The exact yields of the plots treated at various times were as follows:—

	Yield per plot Lb.
Nitrated 1 month after planting.. . . .	22.30
“ August 15.. . . .	23.00
“ September 15.. . . .	23.30
“ September 15 and again in spring.. . . .	24.20
Not nitrated at all.. . . .	19.10

The table shows a gain of over four pounds per plot derived from the application of nitrogen by making the application at a period when there were a large number of plants forming their fruit buds for next year's crop.

(2) The size of the individual berry or fruit may further affect the total yield. This may be influenced by spring applications of nitrogen, especially in soils where nitrogen is inclined to be deficient.

(3) Spring applications of nitrogen during the fruiting year may also increase the ultimate yield by improving the set. As in size, this would be more evident in soils low in nitrogen than where the supply of nitrogen is abundant. Results from experiments indicate that the total set of all bloom was increased by about five per cent by a spring application of nitrogenous fertilizer before bloom. A closer analysis showed that the increase on the later blooms such as the quaternary or last formed blossoms ran as high as 26 per cent.

As already intimated it is difficult to set out very definite fertilizer recommendations for all conditions, but the following taken from the recommendations of The Advisory Fertilizer Board of Ontario have widespread application.

“For both strawberries and raspberries, soils high in organic matter are a practical necessity. Owing to comparatively shallow rooting, short season from spring to harvest, and heavy weight of crop in proportion to plant, the soil must have a high moisture-holding capacity, and must be well supplied with readily liberated plant food. Barnyard manure (or green manure crops) must therefore be the basis of a small-fruit soil fertility program. Commercial fertilizers are a useful supplement to, but not a substitute for, barnyard manure. They are particularly useful where nitrogen or mineral deficiencies exist.

Strawberries

1. Barnyard manure, 20-25 tons per acre, applied preferably a year in advance of planting. Supplement at planting time with a complete fertilizer such as 4-8-10, at the rate of 150 to 250 pounds per acre. Apply a total of 200-250 pounds. Nitrate of soda (or equivalent) in split applications (two weeks apart) in late August and early September.


2. Where barnyard manure is not available supplement green manure crops with either:

- (a) 200-250 pounds 50 per cent muriate of potash; 300-400 pounds of 16 or 20 per cent superphosphate broadcast before planting. Some nitrate of soda may be given a month after planting, but the main application should be in August and September as in (1).
- (b) 600-800 pounds per acre of a complete fertilizer, analysing approximately 4-8-10, applied just before planting. Supplement with 200 pounds nitrate of soda in August and September as in (1).

3. In recommendations (1) and (2), a soil of average fertility and mineral content is assumed. Many small-fruit soils are light in character, and likely to be low in phosphoric acid and potash. Failing proper soil analysis, a basic recommendation of 600-800 pounds per acre of an 0-12-15 is suggested; this application supplementing normal fertilizer treatment as in (1) and (2) above.

“Barnyard manure is likely to be a source of weed seeds, with consequent trouble in a newly set strawberry bed. It is therefore advisable to manure a year in advance of strawberry planting, and to grow a hoed crop to eliminate weeds. Also, where manure is not available, or is scarce, preparation of the soil should begin at least a year in advance of planting, and should consist of turning in green manure crops, especially legumes. Clover is generally preferred by growers.

“For strawberries, nitrogen applications in late August and early September are recommended as a stimulus to fruit bud differentiation which takes place mainly during September and October. In other words the condition of the plant in the fall determines the potential crop of the following season. Nitrogen applications at time of planting are not advisable, and in fact may



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FIG. 2.—Autumn Tint—A strawberry leaf showing nitrogen deficiency



FIG. 3.—Autumn Tint—A strawberry leaf showing phosphorus deficiency.



FIG. 4.—Autumn Tint—A strawberry leaf showing potash deficiency.

be injurious. They should be delayed at least a month, or until the plant is well established, with the main applications in August and September as noted.

“Strawberries are generally regarded as preferring soils of an acid reaction. Experimental evidence supports this at least to the extent of indicating that strawberries are acid tolerant, and that definitely alkaline soils are injurious. This apparent acid-loving nature of the strawberry would seem to indicate the desirability of using fertilizers tending to an acid rather than an alkaline soil reaction but, unfortunately, sulphate of ammonia for example, may not be applied safely in August and September, because of risk of plant burning. Also if advance soil preparation involves the growing of green crops, legumes particularly, then a neutral or a “sweet” soil is a practical necessity.”

PLANT SYMPTOMS

As an aid to the diagnosis of faulty nutrition, foliage symptoms of strawberries are useful.

Potash deficiency may be indicated in midsummer by a scorching of the margin of the leaves. At first this takes the form of a pale yellowish margin which later turns brown as if burned or scorched. Plants exhibiting this symptom are generally indicating a desire for more potassium.

Phosphorous deficiency in the strawberry is indicated by a bronzing of the foliage on the upper surface generally accompanied by some purpling on the under side of the leaf. The typical marginal scorch of the potash deficiency is not present.

Nitrogen deficiency is exhibited by pale green or yellowish foliage during summer, which may turn prematurely reddish in colour.

Autumn tints—In late summer or early autumn strawberries develop autumn tints which also indicate the fertilizer requirements. It is seldom that in any plantation one cannot find a few tinted leaves, but unless very prevalent and accompanied by poor growth there is little to worry about.

The coloured figures (2, 3 and 4) depict the autumn tints on strawberries suffering from low nitrogen, low phosphorous and low potassium; the potassium level in this instance not being sufficiently low in midsummer to induce leaf scorch.

HOW TO APPLY FERTILIZERS

In using commercial fertilizers they may be broadcast on the soil previous to planting, and cultivated in or applied between the rows shortly after planting and worked in with regular cultivators.

A word of caution is pertinent at this point.

Applications of nitrogenous fertilizers made at planting or very shortly after, often give injurious results, the young plants not being able to utilize much fertilizer at that time. It is recommended, therefore, that fertilizers such as nitrate of soda or sulphate of ammonia be not applied until at least one month after the plants are set.

Where nitrogenous fertilizers have been used after the plants are forming runners, good results have come from broadcasting nitrate of soda right on the plants during a dry day. On such a day very little adheres to the foliage, and if a piece of bagging or brush is dragged over the plantation any nitrate that does adhere is quickly dislodged. With sulphate of ammonia, this method has not been so successful, considerable foliage injury resulting from this treatment. Apparently between the rows is the only method of application for this fertilizer.

PLANTS AND THEIR TREATMENT

NURSERY-GROWN PLANTS

The majority of the nurseries issue their catalogues at the beginning of the new year. The varieties to be grown should be chosen and the order placed early in the winter with date of shipment specified. It is of very little importance in what section of the country the plants are grown, except that stock in the southern districts may be too far advanced for successful planting when spring opens in the northern sections. The plants should be ordered to arrive as early in the spring as possible after the soil can be worked. Only the best obtainable stock should be used for setting a new plantation.

If the plants are obtained from a distance it is desirable to order more than are actually required, as there is usually considerable loss. The extra plants may be heeled-in and used to fill the vacancies as soon as it is known which plants are not going to grow. Strawberry plants will stand shipment for long distances if properly packed. It is usually more satisfactory, however, to order from a nearby nursery, in which case the plants are for the most part dug a short time before they are required for planting.



FIG. 5

- No. 1—Over-developed crown, and too small a root.
 No. 2—Crown and root too small.
 No. 3—A very young and unsuitable plant.
 No. 4—A properly developed plant for transplanting.

The plants should be set out as soon as possible after their arrival. It is often, however, not convenient to plant at once; but in any case, when the plants are received from the nursery, they should be carefully unpacked and heeled-in, or trenched. If permitted to remain in the original package for a short time, they are liable to heat or dry out, and may be seriously injured. Roots in good condition are of a light or yellowish colour, while those which have heated are dark and it is a waste of time to set out plants with such roots.

The plants should be heeled-in in a well-drained spot protected from the sun and wind. V-shaped trenches about six inches deep and placed fairly close together are the most satisfactory. If the plants are tied in bunches, each bunch should be opened, the plants separated and spread out in the trench, thus allowing the moist earth to readily come in contact with the roots.

The soil should be firmly tramped or packed against the roots to prevent drying, but do not permit the crowns to be covered. It is desirable to water the plants well after heeling them in. By the time the soil is ready for planting these heeled-in plants may have made new roots and be in better condition for planting than if they had been set out at once.

The number of plants required for an acre if set out 18 inches apart in the rows, is about 8,300, and to provide for loss in shipment at least 8,500 should be ordered. If a free plant-maker like Senator Dunlap is planted, the plants need not be less than two feet apart in the row, and 6,500 plants should be sufficient to order.



FIG. 6.—A first-class plant, trimmed for planting; plenty of young white roots.

Pot-grown plants are the most satisfactory for autumn planting. These plants may be purchased from nurseries which specialize in that type of stock, but are usually expensive and only justified under special conditions. Pot plants are obtained by sinking 2½-inch pots to the rim in the ground several weeks

before the plants are to be rooted. The pots are filled with rich friable soil and sunk from six to eight inches from the original plant. As soon as the new runners reach the pots, they are placed over the soil and soon root and make good plants by late summer. The advantage they have over plants rooted in the ordinary way is that when they are transplanted they are taken from the pot and replanted with a ball of earth without disturbing the roots. Hence they are but little checked and will soon go on growing again, making strong plants which will bear more fruit than those rooted in the ordinary way.

It is a good practice to prune the plants before they are set out; all the larger well developed leaves, except about two of the healthiest ones, should be removed. This prevents any excess loss of moisture before the plant becomes established and may often save it when dry weather sets in immediately after planting. Long and straggling roots are best removed at this time to facilitate planting.

HOME-GROWN PLANTS

When possible, it is better for the grower to raise his own plants as they can be dug and used fresh. Moreover, in recent years many other problems have arisen such as degeneracy, root-rot and tarsonemid mite. These can be much more readily controlled by such a practice. It is more desirable, for this purpose, to have a propagating area than to take plants from old beds which have fruited or from the outer edge of the newer rows which are going to fruit for the first time, as runners from a fruiting plantation lack vigour.

Plants for propagation purposes should be raised by the matted-row method, regardless of the general planting system to be used in the commercial plantation. The propagation rows are planted $3\frac{1}{2}$ feet apart, and cultivation is practised between each row. The plants are set 18 inches apart in the rows.

The grower should at the outset endeavour to plant only really healthy vigorous strains of a variety. Following planting, the propagation bed should be rogued frequently, at least three times on a good stock and five times on an indifferent one. Rogue out all the unhealthy or suspicious looking plants and those lacking vigour. It is better to recognize roguing rather from the point of view of looking for definitely healthy plants than for abnormalities. Roguing is one of the most important operations in growing strawberries.

In selecting the plants for transplanting, the whole propagating row should be dug and the best plants only selected. These are plants with a large root system and well developed crowns. The oldest plants with oversized crowns and smaller root systems should be avoided, likewise those with very little root and small crowns. Aside from this, experience shows that it matters little whether the plants come from close to the original parent or far from it. Only those plants with white roots are used. The ones with dark or discoloured roots are probably too old or have been injured by winter, and are discarded.

PLANTS FOR SHIPMENT

In shipping strawberry plants great care is necessary in packing to avoid drying out and overheating. At the Horticultural Division, Central Experimental Farm, three sizes of packages are commonly used. One size is a small mail package, for from a dozen to 50 plants, another is an ordinary 11-quart basket for 100 to 200, and the third is a regular slatted crate for large shipments.

(1) The small mail package is very popular for customers only wishing small lots and if care is taken in packing, is satisfactory for rather long distances. The plants are tied into a bundle with raffia and then wrapped around with sphagnum moss, which has been well soaked and squeezed free of surplus water. A piece of oiled paper is then securely wrapped around the package so that the leaves are exposed (see figure 9) and the whole then wrapped and tied in manilla wrapping paper. If preferred, one may use a specially prepared paper

which consists of two layers of paper stuck together by tar compound. This is both waterproof and airtight and prevents drying out (which is the object of the oiled paper) while the open end provides the necessary ventilation.

(2) The basket package consists of an 11-quart basket without the handle, and is very useful where from 100 to 200 plants are to be shipped. The basket is simply lined with a piece of oiled paper or other prepared paper and then



FIG. 7.—Eleven-quart basket package before wrapping.



FIG. 8.—Eleven-quart basket package ready for shipment.

lined with moss; the plants being packed in upright with moss between every few layers. A piece of burlap over the whole makes it secure and permits of sufficient ventilation (figures 7-8).

(3) For large shipments a regular strawberry crate is an excellent package. It is desirable to line the crate with oiled paper and then with a thin layer of wet moss. The plants can then be packed in an upright manner with a little

moss between each layer. After the first tier of plants is in, if it is necessary to put in a second, a slatted bottom may be inserted and cleats fastened to the sides, and the second tier packed as the first. After the crate is filled a slatted top without any further covering completes the package.



FIG. 9.—Mail package ready for shipping.

WHEN AND HOW TO PLANT

Strawberries may be planted either in the spring or fall, depending on the district they are to be grown. In British Columbia fall planting is preferable to spring planting, while in Quebec and Ontario spring planting is more desirable. In most districts in Canada, planting early in the spring as soon as the soil can be prepared is usually preferable to fall planting. Some growers believe that by planting in August, they can secure a sufficient stand of plants to obtain a crop the following year. This is, however, exceedingly difficult to attain even when using pot-layered plants and little benefit is gained. There is, nevertheless, another aspect which may favour fall planting, namely, setting the plants in the fall preceding an anticipated spring planting. In the milder districts, plants set in late August or September in a favourable location generally come through the winter very satisfactorily, and will commence runner formation earlier than spring set plants. The value of these early runners is discussed in detail in the section dealing with the role of nitrogen in strawberry culture, and on the basis of the data presented, it will be readily seen how fall planting might materially increase the crop. With plants set in the fall, it is usually necessary to remove surplus runners in the early part of the second fall to prevent overcrowding. The greatest disadvantage in fall planting is the frequency of dry spells in the autumn which makes transplanting difficult and uncertain until too late in the season. Of course where irrigation is available, this factor is eliminated. There is always the danger, particularly in Eastern Ontario and Quebec, of fall-set plants not becoming firmly rooted prior to winter setting in, in which case the plants heave badly the following spring and a heavy loss of plants results. It should also be borne in mind that fall-set plants require extra care in cultivation and winter protection.

When spring planting is practised, it should be the object of every grower to plant as early as possible to get the benefit of the cool weather and moisture of that period of the year.

Before commencing planting operations it is important that the soil be in first class condition. Brief mention was made of this in an earlier paragraph but it will not be amiss to again draw attention to the matter. On light loamy soil, after the disk and levelling harrows have completed their work, it will generally be sufficient to roll the land before marking, but if the soil is at all inclined to lumpiness, it is a good practice to go over it with a plunker previous to rolling.

The plants may be set in straight rows by being planted against a string drawn taut across the patch, provided the distance is short. A home-made marker is most generally employed. This implement may be cheaply constructed out of 2-inch by 4-inch plank, in which a series of half-inch holes are bored along the centre of the widest surface, six inches apart and in these are inserted wooden teeth. A handle attached at right angles to the 2- by 4-inch piece and supported by means of iron braces, serves as a tongue for drawing the marker over the ground (see figure 10).



FIG. 10.—A quick method of marking out rows.

As soon as the distances have been decided upon, the marker is first pulled across the field to mark the rows and is then drawn at right angles to the rows, to mark the intersections where the plants are to be set. As the distance between plants is not the same as the distance between the rows the teeth will need to be changed accordingly. Long rows are desirable, as, with them, time will be saved in cultivation.

Planting may be done with a spade or with a trowel or dibble. Some growers stake off rows one way from three and a half to four feet apart, and with a light plough make a shallow furrow and then set the plants about 18 inches apart along the sharp edge of the furrow, drawing the soil about the

plant and firming it well with the hand. When planted with a spade two persons are required to do the work, usually a man and a boy. The man inserts the spade into the ground and by pressing it backward and forward opens a hole (figure 11-1). To prevent the soil from refilling hole, the boy places the plant in position (figure 11-2) before withdrawing spade. The spade is then withdrawn and inserted a short distance from the plant and soil is pressed about roots completely filling in the hole (figure 11-3). In the final operation the man presses the soil firmly around the plant with his foot, leaving the crown of the plant level with the ground (figure 11-4). This method is very rapid and if the soil is well pressed against the plant, is quite successful.

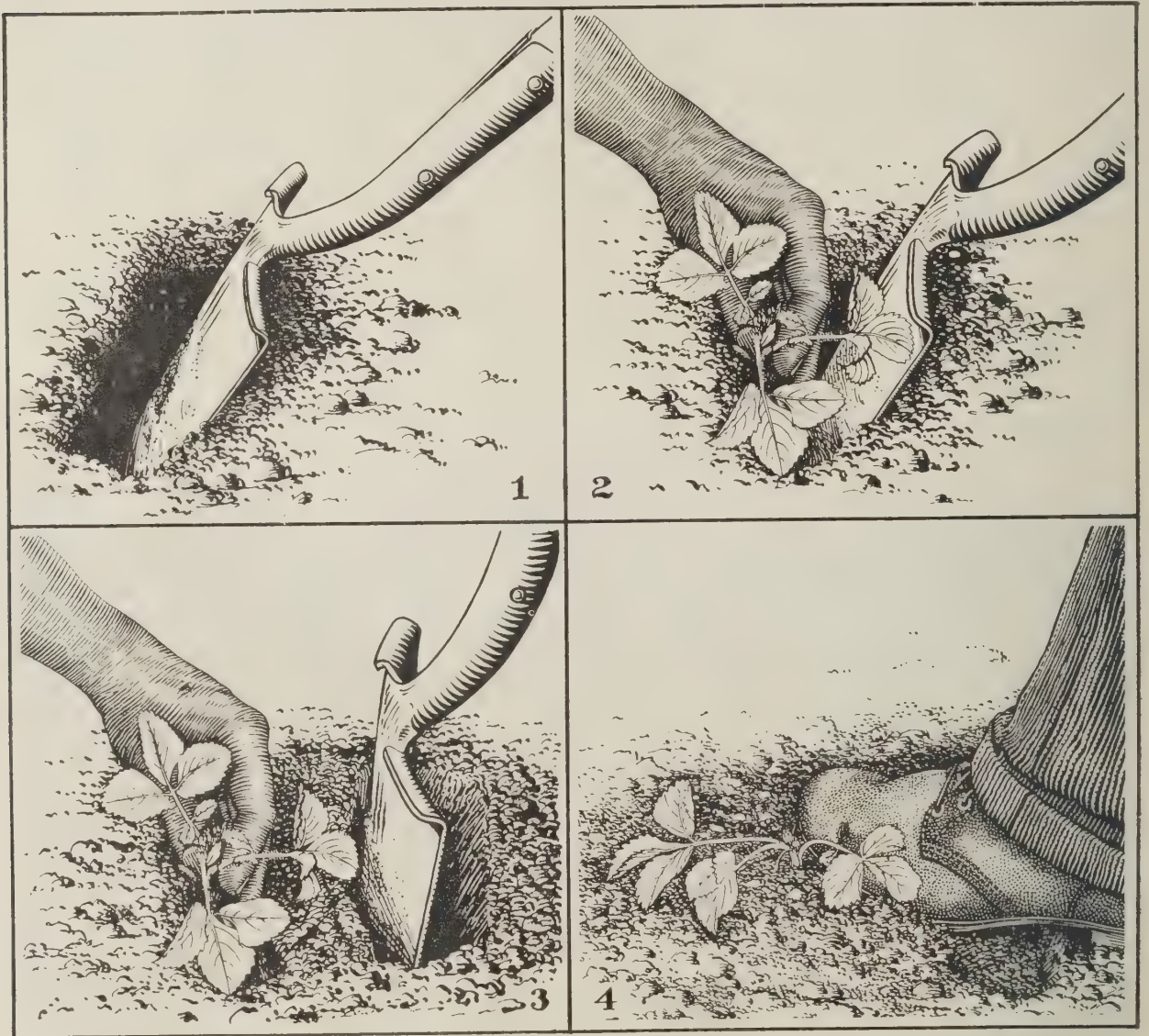


FIG. 11.—1. Spade inserted and hole opened. 2. Placing plant in position. 3. Pressing soil against roots. 4. Firming soil around plant.

A surer method of obtaining a stand is by using a trowel or dibble for opening the hole, whereby the plant is more likely to be set the proper depth, and more care usually exercised in spreading the roots and firming the soil about the plants. By this method the same person opens the hole and sets the plants. Great care should be taken to have the crown of the plant just at the surface of the ground after it has been pressed in when planted. If the plant is set too high the roots and crown will dry out, and if too low will be smothered. Care should be taken when planting to spread the roots against the side of the hole.

Planting machines are used by some growers, and give good satisfaction when the work is well done, the soil in very good condition, and the season favourable. When the soil is not in good condition, and not well levelled, the plants are sometimes set at different depths and the stand is not good. When planting, the plants should be carried in wet sacking or in a pail with water in it, as the roots must not be allowed to dry out.

Professor T. G. Bunting of Macdonald College has the following to say on the use of transplanting machines on large areas:

“A transplanting machine is indispensable on the larger acreages of strawberries. It greatly reduces the cost of planting, increases the speed and provides facilities for watering the plants as they are set in the rows if the soil is somewhat dry. It is operated by a man and team, with two boys, who, seated at the rear and at the sides, place the plants in the trench made by the machine. The depth of this trench and the amount of water applied may easily be regulated. This machine, with experienced labour, will set as many as 25,000 plants, three to four acres, per day at a cost of 40 to 50 cents per thousand. To this must be added some additional cost for the more careful preparation of the plants for machine planting as compared with hand setting. The plants should be carefully prepared, uniform in size, have the roots well straightened out and all dead leaves and runners removed so that the operators may handle them as rapidly as the machine moves. In loose or light soil the machine may not pack the soil firmly enough about the roots, and the operators may miss an occasional plant especially at the ends of the rows. In this case it is well to have an additional man follow the machine to tramp the soil about the plants, straighten misplaced ones, and fill in any gaps that may occur. Careless planting may mean greatly decreased yields and low returns”



FIG. 12.—Planting machine; showing box containing plants.
(Courtesy Ont. Govt. Motion Picture Bureau)

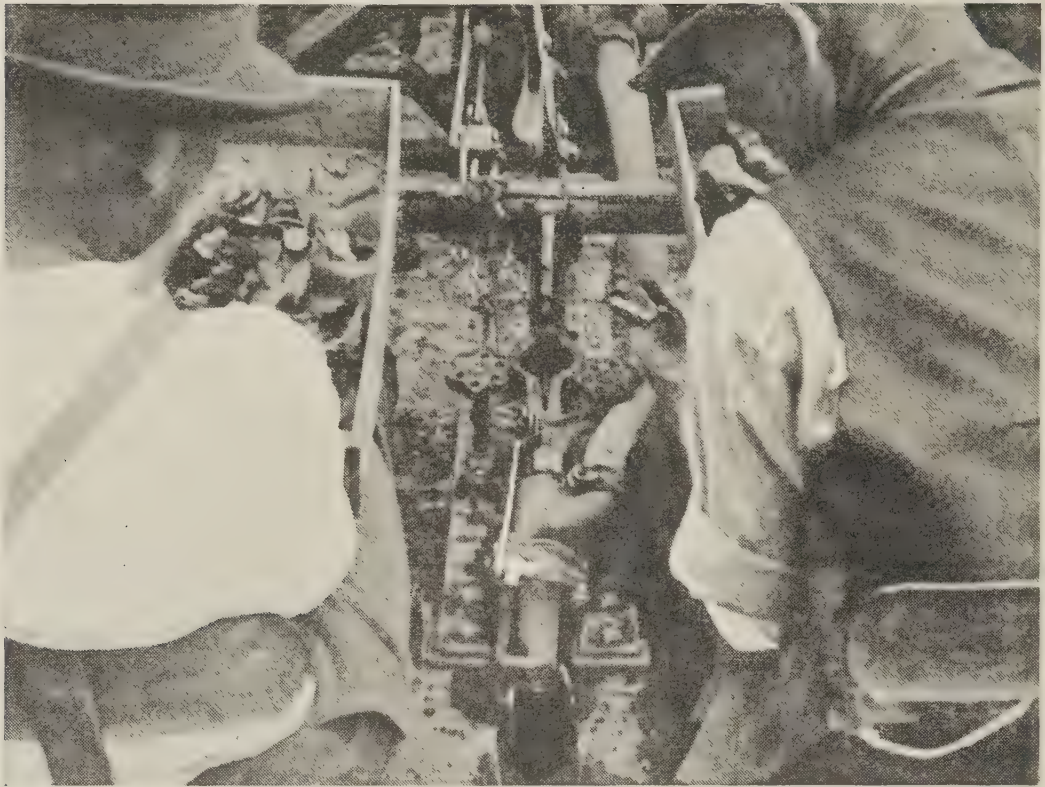


FIG. 13.—Planting machine; showing operator ready to place plants.
(Courtesy Ont. Govt. Motion Picture Bureau)



FIG. 14.—Full view of planting machine.
(Courtesy Ont. Govt. Motion Picture Bureau)

THE MATTED-ROW SYSTEM

There are in general two systems of growing strawberry plants, the matted row, and the hill system.

In Eastern Canada most commercial growers use and prefer the matted row, whereas in British Columbia the hill system is in general use. The great objection to the hill system in the East is the danger of heaving which causes considerable root and crown injury with consequent reduction of crop. After six years of repeated trials with the hill system at the Central Experimental Farm, Ottawa, in only one season did the acreage yields approach those obtained from the matted-row method.

The planting distance, in the matted-row system is to some extent regulated by the variety, locality and soil type. Because of the value of having as large a percentage as possible of August-formed plants, comparatively narrow rows will give greater returns per acre than wider ones. When a large number of narrow rows are obtained it becomes possible to get a full stand of plants earlier in the season after which later formed runners may be removed by an edger or cutter. A distance of three to three and one-half feet between the rows as planted is ample and the spacing of the plants in the row may be regulated by the varieties used. Senator Dunlap, a very prolific plant-maker may be safely set at 24 inches while varieties like Parsons Beauty, Glen Mary, and Portia are satisfactory at 18 inches.

While many who grow strawberries in the matted row do not take the trouble to place the runners as they form, but let them root without assistance, it pays to place them, as the sooner they take root the stronger the plants will be by autumn, and the more fruit will be produced next season. All that is necessary is to place the runners so that they will be as uniformly distributed as possible in order to economize space, and to put a little soil over them to hold them in place but leaving the terminal buds bare. In the Prairie Provinces where winds prevent the prompt rooting of runners, it is important to hold them in place until they root with pieces of sod, stones, an inverted crotch, or by any other suitable method. To get the best results, runners should not be nearer than from four to six inches apart, preferably six inches, all others being destroyed; but in practice it is often difficult to accomplish this and to restrict them to this area, as some varieties make a great many runners. These are, however, the kinds which have the most need of thinning, as when the plants are very thick the fruit is too small. The width of the row formed by autumn will depend on the number of runners which are made, but if planted early and properly cared for, most varieties will make a row two feet or more wide. At this width there would be a path 18 inches wide left for the pickers between the rows. As some varieties would cover the whole space between the rows with runners in one season, it is necessary to remove those not wanted with the cultivator or hoe.

The so-called single-hedge and double-hedge-row systems are merely modifications of the matted row. Instead of the runners being allowed to form indiscriminately, most of them are removed and the rest placed where it is desired for them to grow. In the single-hedge-row system, two or four runners are left on, and these are placed in line with the row on each side of the parent plant.

When grown in this way the rows are two and one-half to three feet apart and the original plants about two feet or more apart in the rows. When the row is formed the plants are six to eight inches apart in a single row.

In the double-row system, six runners are left to each plant in the row and two on each side of the original row, all about equal distance apart. Trained in this way the original rows should be about three feet apart and the plants two feet or more in the row.

The twin-hedge-row system provides for two rows 16 to 18 inches apart with the plants at first about two feet apart in the row, with a wider space of two feet for a path and for cultivation between each pair of rows. The hedge-row system requires considerably more labour than the matted row but the returns will often well pay the grower for the extra amount of work. By this method the plants get more opportunity to develop strong crowns; better cultivation can be given, and more of the plant food in the soil will be available, resulting in larger and better fruit.

HILL SYSTEM

This system is the one largely used by British Columbia growers excepting those of the Okanagan and West Kootenay. In this system the plants are generally set about 18 by 36 inches. This permits of cultivation both ways during the first season. Where this method succeeds large berries may be grown. The blossoms are pinched off the first season as in the matted-row system and all runners are removed as formed and before rooting. This will generally require about four or five cuttings, and may be done with a knife, a very sharp hoe or a pair of sheep-shears. By this method very strong crowns are developed; the plants having more room, become vigorous and as a result the fruit is large, and sometimes as good crops are obtained as from the matted row.

However, winter injury is much more likely to occur when plants are grown individually, and if plants grown in hills die from heaving or from some other form of winter-killing they leave large blanks, causing a great lessening of the crops. Unless kept well cultivated or well mulched in summer, plants suffer more in drought periods in hills than in the matted row where the crowns are better protected by foliage. If the plants are kept well mulched, very fine fruit is produced when strawberries are grown in hills, which sometimes makes this method preferable when growing strawberries for home use. In the milder parts of British Columbia, especially where there is a dry summer without irrigation water available, the hill system is used, as competition for moisture is less than in a matted row.

The Dominion Experimental Station for Vancouver Island, at Sidney, British Columbia, has published the following report on a trial of several systems of growing strawberries under their conditions.

SYSTEM OF PLANTING—VANCOUVER ISLAND

Method of Growing	1924				1925			
	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries
	lb. per acre	lb. per acre	lb. per acre		lb. per acre	lb. per acre	lb. per acre	
Hill.....	3,826	1,618	5,444	70.2	814	1,355	2,169	37.5
Hedge row.....	3,878	1,693	5,571	69.6	605	702	1,307	46.3
Half-matted row.....	3,391	1,751	5,142	65.9	1,549	1,113	2,662	58.2
Full-matted row.....	1,510	1,002	2,512	60.1	1,321	1,284	2,605	50.7

YIELD FOR TWO YEARS

Hill.....	4,640	2,973	7,613	60.9
Hedge row.....	4,483	2,395	6,878	65.1
Half-matted row.....	4,940	2,864	7,804	63.3
Full-matted row.....	2,831	2,286	5,117	55.3

It will be noted that in one year (1924) the hill system outyielded the full-matted row by more than 115 per cent, and in 1925 the matted row outyielded the hill system by about 20 per cent, while the results for two years were decidedly in favour of the hill system.

CARE OF THE YOUNG PLANTATION

During the first season frequent cultivation is essential to success. As soon as the plants are set out a cultivation with a spike-tooth cultivator should be given. This should be followed up at intervals of about two weeks or oftener, largely depending upon soil and weather conditions. Not only is this cultivation necessary for the elimination of weeds, but also for maintaining a friable condition of the soil necessary for the young rooting runners, and to provide air to the soil for the liberation of plant food. On all except very light soils the early cultivations (after the first one) should be fairly deep, in order to loosen the soil and promote soil activities. For this purpose a scuffler will generally give better results than the spike-tooth. The strawberry, being a plant whose roots go almost straight down, can be cultivated at close quarters.

Hoeing also will be necessary to destroy weeds which cannot be got at by the cultivator. Some growers prefer a wheel hoe or hand cultivator for this purpose, and generally two or three times during the first year is all that is necessary to go over the plantation with this implement. As the season advances and the runners commence to form, it will become necessary to narrow the cultivator in order not to disturb the newly rooted plants. After midsummer when light cultivation is sufficient, the spike-tooth cultivator is used. The placing of the runners can usually be done when hoeing through the plantation. On small plantations it is generally possible to pay more attention to this than on larger areas. It is a good plan when cultivating to start always from the same corner and in the same direction, as in this way one is not so liable to rip out plants which the cultivator has previously trailed into position.

WINTER PROTECTION

Strawberry plants may be injured by extreme winter temperatures or by heaving caused by intermittent freezing and thawing. Proper mulching will provide the necessary protection. It also shelters the crowns and roots from the drying action of winter winds.



FIG. 15.—Strawberry plantation, Central Experimental Farm, Ottawa, Canada.
Mulched for winter.

There are many materials suitable for mulching a strawberry plantation. Clean wheat or rye straw is probably the most satisfactory as it does not pack tightly over the plants. Marsh hay is good as it is relatively free from weed seeds. Green manure is sometimes used, but as it usually contains many weed seeds, and sometimes may smother the plants, it is not recommended.

The mulch should be applied after the plants have become dormant, preferably after the first severe frost before the temperature falls to around 20° F., which would be likely to injure the crowns of the plants. This period will vary considerably with locality but is generally in the month of November. It is advisable to spread the material uniformly over the plantation; two or three inches being sufficient depth to afford necessary protection to the plants. A heavier mulch may smother the plants and further may cause heating in the spring before it is removed. The amount of mulch required is from three to three and one-half tons per acre.

It has occasionally been recommended to grow a mulch crop, such as oats, between the rows of strawberries during the latter part of the summer which could be used to hold the snow in the winter. This practice is not desirable since the two crops compete with each other for moisture and nutrients.

The mulch should be allowed to remain on the plants until the frosty weather of the early spring is over, the duration of time depends on the behaviour of the plants. The best index for removing mulch is the appearance of new leaf growth and a slightly yellowed foliage colour. In any case, the mulch should not be removed as long as the plants remain dormant. When the plants are uncovered, only partially remove the straw to the pathways between the rows. A light scattering of straw mingled among the plants is beneficial, as it helps to conserve moisture.

RENEWING THE PLANTATION

The most satisfactory results are obtained when only one full crop is gathered from a plantation. If, for instance, plants are set this spring, the plantation should be ploughed up after the fruiting season of next year. There will thus be a new plantation made every year. By this system, much better fruit is obtained as the plants are not so thick in the row and the soil can be kept freer of weeds. Where the white grub is troublesome, it is important to renew the plantation every year, as this pest increases rapidly in old plantations and sometimes almost ruins the crop. It is quite possible to obtain two good crops or even more from a plantation by careful management, but the older the plantation the less the crop will be and the smaller the fruit as a rule. In the Maritime Provinces where the summer is relatively cool and moist, plantations are left longer than in the drier and warmer parts of Canada.

RENOVATING AN OLD BED

If the land is free of weeds it is possible to obtain good results by keeping a plantation longer than the one year. This usually entails a certain amount of renovation at the end of the first fruiting season. The amount and system of renovating will largely depend upon the condition of the plantation. Experience has shown that where the manure is applied the year previous to planting, and dependence placed upon fertilizers for subsequent applications of plant food, there is very little trouble with weeds. Under such conditions it is comparatively easy to renovate. The method is as follows: as soon as the picking is over, the straw is raked up and carried to one side of the plantation. After this, each row is ploughed or cut down to a width of about 18 inches (figure 16). The plants thus ploughed up are then gathered up and destroyed, and the cultivator run through the rows. The few weeds growing among the remaining plants are pulled by hand. As soon as this cleaning up has taken place, an application of

nitrate of soda is made to the plantation at the rate of 200 pounds or more to the acre. Sulphate of ammonia would be satisfactory except for the fact that it is difficult to broadcast it over the plants without causing serious burning. If used it should only be put between the rows. Frequent cultivation throughout the remainder of the year will usually result in the plantation going into winter in good condition.

When the old bed is grown up with grass and weeds, more drastic measures are necessary. In such instances, after the removal of the straw the whole plantation is mowed and the mowings burned as quickly as possible. After this the rows are narrowed down to about one foot in width and the ploughed-out plants raked up and destroyed. This leaves a narrow row of plants and weeds that can then be hoed to leave clumps of plants every eight or nine inches.



FIG. 16.—Renovating an old strawberry patch. The rows are just narrowed down by ploughing through the centre.

In narrowing the rows it is always well to work from one side of the plantation so that the old row is split down the centre leaving the newer plants on the outer edge as the remaining narrow strip. After this hoeing, an application of nitrate of soda or manure ploughed in between the rows is given, followed by frequent cultivation.

Some growers, after narrowing the rows, do the cross-thinning by a harrow or drag, and then finish off with the hoe and cultivator.

In some parts of the Maritimes where plantations fruit for many years and where the rows are a little farther apart, the practice is simply to plough between the rows so as to leave a wide furrow, which is filled with manure. A cross-harrowing then covers this furrow with earth. This is followed up with hoeing, hand weeding and cultivating.



FIG. 17.—Renovating an old strawberry patch. After ploughing the rows, the land between the rows is hoed to turn up the old plants.



FIG. 18.—Renovating an old strawberry patch. After cultivating, hoe around the plants remaining with a three-cornered hoe, and weed.



FIG. 19.—Renovating an old strawberry patch. The plants are next thinned in the row and the debris is raked up and burned.



FIG. 20.—Renovating an old strawberry patch. After removing the debris, apply a little nitrate of soda and cultivate it in.

IRRIGATION

Surface or ditch irrigation can be used in fields with gentle, fairly uniform grades, but is only practical on heavy soils. Furrows are ploughed between the rows and are fed from a headland row which runs at right angles to these. A goodly supply of water, from some natural or artificial source, is also essential.

A comparatively new and promising system of surface irrigation is by means of porous canvas hose. By this method the water does not come in contact with the leaves and fruit, as is the case with the overhead system. This tends to lessen the spread of leaf and fruit diseases if present. The hose is laid along the row on the ground and as each row is watered, it is moved on to the next row. A cap is fitted in the end of the hose, so that the water is compelled to ooze out through the pores of the canvas. It is important that the hose be cleaned and dried at the end of each season, otherwise its life will be relatively short.

VARIETIES

It occasionally happens that a grower having a variety of strawberry which yields much better with him than other varieties which he has growing alongside, decides to discard all other kinds and grow that one variety. He does so, and is disappointed to find that he has very few berries, and these ill-shaped and worthless. He does not know what to think about it, but writes to the Experimental Farm to learn the cause of the failure. The reply is sent back: "Are you aware that the flowers of strawberries may be either perfect (bisexual) or pistillate; in other words, do you know that some varieties of strawberries produce blossoms which have both male and female organs, while other varieties have only female organs? If you do not, the solution of your difficulty is very easy."

The male and female organs in plants perform the same functions as in animals. The fine dust formed on the stamens, which is shed when the flower is in bloom, is the fertilizing agent, which falls on the pistil and fertilization takes place. If the stamens are absent, or nearly all absent, as is the case in imperfect or pistillate flowers, no fruit, or very little fruit, is formed. If a perfect (staminate or bisexual flowering variety) and an imperfect flowering variety are growing in close proximity, the flowers of both will be fertilized, as insects and wind carry the pollen or dust from the perfect to the imperfect flowers. It very often happens that the imperfect flowering varieties produce the best crops when properly pollinated, and this experience may lead fruit growers who are ignorant of the foregoing fact to make the mistake of planting only one variety, which may be imperfect. While most flowers may be classed as either perfect or imperfect there are gradations between. Occasionally a staminate variety is as imperfect as a pistillate, or more imperfect, as it will not set fruit under any conditions.

A row of a perfect flowering sort should be planted to about every two or three rows of an imperfect variety for good results. The proportion will depend on the amount of pollen produced by the perfect sort. Of course, it is not necessary to plant an imperfect variety at all, as there are plenty of good sorts which have perfect flowers. It is essential to have the perfect and the imperfect varieties in full bloom at the same time, as if the former bloomed before the latter there would be no object in planting it as a pollinator.

Owing to the ease with which a new variety of strawberry is originated, and the short time it takes to fruit the same, the number of new sorts each year in America is very large. Only a small proportion of those which are produced are better than, or even equal to, the best which are already on the market, but often the originator is not the most competent person to judge the relative value of his seedling, and as a result many sorts are offered for sale each year. It is the work of the experimental farms to test these new varieties as they

appear, and having compared them with standard sorts, publish, when deemed advisable, a reliable description of them and the yield obtained. During the past 30 years 576 named varieties have been tested at the Central Experimental Farm. Of this number only a very few of those grown during the first two years are still under test. This does not mean that nearly all the varieties tested at first have deteriorated, but that better kinds introduced since have taken their places. In 1926 there were 87 varieties under test.

CAUSES OF POORLY SHAPED BERRIES

There are two causes of poorly shaped berries or nubbins. The most common is unfavourable weather conditions. The flower and growing fruit are very susceptible to injury from cold winds or cold weather. Sometimes part of the berry is injured, while another part being perhaps more protected, escapes and develops normally. Another cause of poorly shaped fruit is faulty pollination.



FIG. 21.—Imperfect flower.

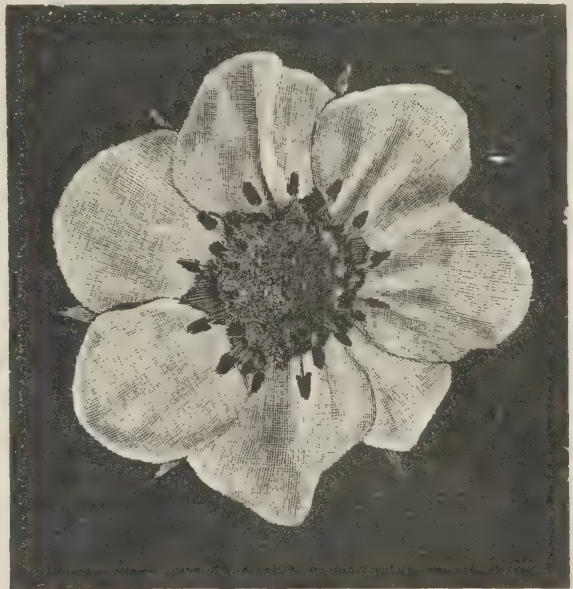


FIG. 22.—Perfect flower.

The supply of pollen is either deficient in the fruit itself, or there has not been enough brought by wind and insects to pollinate all the stigmas of the berry. Bees do not work much in bad weather. Extremely dry, hot weather may injure the pollen. Rainy weather during the blossoming season may cause much poorly shaped fruit by preventing proper pollination. The remedy is to plant varieties with abundant pollen and mix these with any imperfect sorts which may be grown. Keeping the plants back as much as possible in the spring, by not removing the mulch early, will help to avoid injury from cold winds and frosts.

SELECTION OF VARIETIES

In addition to considering the sex of the varieties to be planted, there are other characteristics of the fruit and plant which the grower should consider in making his selection.

Firmness or ability to hold up and ship well, while not the character generally considered first, should take first place in determining the fitness of a variety for commercial use. Too much attention has been paid in the past to yield, with the result that many of the most common varieties are exceedingly bad shippers and reach the market in such poor condition that only in years of great scarcity do they realize anything like profitable prices. Appearance and size are two other considerations of prime importance; yielding ability is also of course a great factor; while hardiness, disease resistance or susceptibility, runner-forming habits, and adaptability to certain soils all have to be given

consideration in the final selection. Eating quality, especially for discriminating markets, is of prime importance, and season of ripening has much to do with the final selection of some growers who are catering to special markets where early and late fruit is in special demand.

Probably no fruit is so susceptible to varying soil and climate conditions as the strawberry, so that a variety which does well in one district does not succeed in another close at hand.

In the following lists the varieties are given which in each province are the most popular.

EVERBEARING STRAWBERRIES

The so-called everbearing or fall bearing strawberries are increasing somewhat in popularity, particularly in the Prairie Provinces. A plantation of everbearers should be handled in a somewhat different manner than a plantation of June bearing sorts.

Sometimes it is expected that the everbearers will produce a full crop in June and follow with another crop in the fall. Experience indicates that better results are obtained by taking a crop in the fall of the planting year, and a June crop in the following season. With this in view and considering that these do not make as many runners as the June sorts, the planting scheme is modified somewhat.

In the first place if planted in the early fall or late autumn there are not only earlier rooted stolons but more plants for the first fall crop; and secondly, if planted closer together than is ordinarily recommended for June sorts, much greater returns per acre are secured. Planting in double rows three feet apart from centre to centre is sufficiently far apart. The two rows constituting the double rows may be one foot apart, with the plants one foot apart in each row, but placed so that they are alternate instead of opposite. This is close planting, but sufficiently far apart for any varieties tested that are worth growing.

As the fall bearer is forming fruit buds during early summer or shortly after rooting for the fall crop, it is imperative for best results to have an available supply of plant food, especially nitrogen. An application of nitrate of soda made in June in soils not overstocked with nitrogen will give good results in this respect.

VARIETIES RECOMMENDED FOR VARIOUS DISTRICTS

In a bulletin of this kind which remains in print for several years it is only possible to refer to those old and true varieties which have definitely found a place and to a few of the newer ones which have promise of being outstanding. There are many varieties being introduced these days but only a few appear to find extensive favour.

It is important to remember that strawberry growing is beset with more diseases and disorders to-day than formerly and this appears to be the cause for the early decline of many new sorts which otherwise possess much merit. It is rather significant that certain old sorts like Dunlap appear to stand up to these various disorders better than many newer varieties that are really superior in all other respects.

The recommendations which are in this bulletin are based on reports from Dominion experimental stations and provincial institutions.

MARITIME PROVINCES

Commercial.—Senator Dunlap (per.), Premier (per.).—Jessie (per.) for Yarmouth Co., N.S.

Newer sorts for trial.—Fairfax (per.), Dorsett (per.), Ralph (per.), Dick (per.), Charles for local use only (per.), Carl (per.), Tupper (imp.), Jim (per.).

QUEBEC

Commercial.—Senator Dunlap (per.), Premier (per.), Parsons Beauty (per.).

New sorts for trial.—Dorsett (per.), Fairfax (per.), Clare (imp.), Dick (per.), Carl (per.).

ONTARIO

Commercial.—Premier (per.), Parsons Beauty (per.), Senator Dunlap (per.).

Newer sorts for trial.—Dorsett (per.), Fairfax (per.), Culver (per.), Caledonia (per.), Cata (per.), Louise (per.), Claribel (imp.), Howe (imp.), Borden (per.) Simcoe (per.).

PRAIRIE PROVINCES

Commercial.—Premier (per.), Senator Dunlap (per.), Dakota (per.).

Everbearers.—Champlain (per.), Gem (per.), Mastodon (per.), Wayzata (per.).

Newer sorts for trial.—Dorsett (per.), Fairfax (per.), Ralph (per.), Louise (per.), Margaret (per.), Robert (per.).

BRITISH COLUMBIA

Vancouver Island.—Marshall (per.), Magoon (per.), British Sovereign (per.), Paxton (per.).

Lower Mainland.—Senator Dunlap (per.), Marshall (per.), Magoon (per.), British Sovereign (per.).

Salmon Arm.—Magoon (per.), British Sovereign (per.), Paxton (per.).

Okanagan.—Gibson (per.), British Sovereign (per.), Senator Dunlap (per.).

Kootenay.—Parsons Beauty (per.), Magoon (per.), Senator Dunlap (per.), Van Sant (per.), Gibson (per.), British Sovereign (per.).

DESCRIPTION OF VARIETIES

BRITISH SOVEREIGN (per.).—A variety originated in British Columbia. The history of this variety as recorded in Circular No. 58, British Columbia Department of Agriculture, is as follows:—

“This is a variety which, so far as is known, is of British Columbia origin. In 1920 a Japanese grower of Coghlan, B.C., purchased some Campbell strawberry plants from Queensborough, Lulu Island. Six plants were noted to be different; they were allowed to produce runners and were kept separate from the main planting. In 1921 about 100 plants were set out. By 1923 the variety was beginning to attract attention. It was jokingly called “Bull’s Tongue.” This name was twisted by Japanese growers into “Gold Stone”, and then to “Golden White” and “Gordon White.” Maple Ridge growers who secured the variety about 1926 gave it the name Victoria. Plantings did not increase very rapidly, but by 1928 production was sufficient to make Prairie shipments, and the berry attracted attention on the Prairie markets and also on the wholesale market in Vancouver.”

DAKOTA (per.) (Jessie \times wild strawberry of Manitoba). Orig. N. E. Hansen, Brookings, South Dakota. Fruit below medium to small, bright red; quality above medium; runners very numerous. This variety has proved hardier than any other variety tested at the experimental stations on the prairies.

DUNLAP (Senator Dunlap) (per.).—Parentage uncertain. Orig. 1890. J. R. Reasoner, Urbana, Ill.; introd. 1900. Fruit pointed, wedge and long wedge-conical, necked, medium to large size, deep glossy red; seeds not especially promi-

nent: flesh rich red, juicy, tender; briskly subacid; moderately firm; above medium quality; season early; plants vigorous, large number of runners; foliage moderately good, rusts considerably in old beds. The most generally popular variety. This variety is more suitable for heavy soils. Being a heavy runner maker it should be planted far apart in rows. Although very popular it is not of great merit at Ottawa; producing only about three pickings of good size, falling off almost at once to very small berries.

JESSIE (per.) (Sharpless \times Miner's Prolific). Orig. 1880. F. W. Loudon, Jamesville, Wisconsin. Introduced 1886. An old variety grown in the southern U.S.A., also on the Pacific coast of the U.S.A. Requires high culture and a moist climate. Does well and sometimes better in the second and third crops. Large size, pale colour, and almost white flesh. A good shipper. Largely grown in southern Nova Scotia.

PREMIER (per.)—Orig. A. B. Howard, Belchertown, Mass. Introduced about 1909. Fruit large, long conical to somewhat wedge-shaped, bright scarlet; flesh light red, medium firm, quality good; a fair shipper; productive; season medium early; plant vigorous; runners numerous. This variety has become very popular and is now planted extensively.

PARSONS BEAUTY (per.)—Chance seedling. Orig. about 1895, R. G. Parsons, Parsonburg, Md.; introd. 1899. Fruit obtusely conical, above medium to large in size, bright red, glossy; prominent seeds; flesh bright red, juicy, tender, firm; subacid; above medium quality; season medium late; plant vigorous, large number of runners; foliage moderately good, rusts slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best quality.

MAGOON (per.) (Chance seedling). Orig. W. J. Magoon, Portland, Oregon; introd. 1894. Fruit roundish, somewhat irregular, medium to large, deep red; flesh deep red, moderately firm; subacid; good quality; season medium to late; plant very vigorous, runners only moderately numerous. A popular variety in British Columbia. Has not proved of value at Ottawa.

MARSHALL (per.) (Chance seedling). Orig. 1890, Marshall F. Ewell, Marshfield Hills, Mass.; introd. 1893. Fruit pointed-conical to roundish, large to very large, dark red; rather conspicuous seeds; flesh bright red, juicy, firm; subacid, good flavour; very good quality; season medium; plant moderately vigorous, runners moderately numerous; foliage good though rusting slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best in quality.

PAXTON (per.) (Sir Joseph Paxton)—This is an English variety, but is probably different from the variety grown in B.C. under that name. The B.C. Paxton is reputed to be an imperfect or pistillate variety. A very vigorous grower and good runner maker. Foliage dark green, habit somewhat recumbent. Fruit dark in colour, productive. Of value only in B.C.

ROYAL SOVEREIGN (per.)—One of the best all-round English varieties. It is of excellent quality and is highly regarded for home use in British Columbia. The fruit is of large size and bright red in colour. The plants make many runners. Of no value at Ottawa.

DESCRIPTION OF NEWER SORTS RECOMMENDED FOR TRIAL

BORDEN (per.) (Nor J \times Parsons Beauty) \times (F. Mexicana \times Jessie).—Originated C.E.F., Ottawa. A large sized fruit, conic, deep salmon, very shiny, salmon coloured flesh, fair quality, very firm; an excellent shipper and very attractive; not a heavy runner maker; should either be used for hill system or planted closer.

CALEDONIA (per.) (Marshall \times Howard 17).—Orig. New York State Agr. Exp. Sta., Geneva, N.Y. A dark coloured berry of fairly good quality, firm fleshed, but inclined to be rough and variable in size. Plants vigorous and healthy, and good runner makers.

CARL (per.) (Americus \times Parsons Beauty).—Orig. C.E.F., Ottawa. Large size, well necked berry, firm, bright attractive scarlet colour with pale salmon flesh, fair quality. In some sections has proved a very early variety, but later in others.

CATO (per.) (Marshall \times Howard 17).—Orig. New York State Agr. Exp. Sta., Geneva, N.Y. A very attractive, dark coloured berry, much like Fairfax; flesh salmon colour, firm; fruit slightly necked, fairly early in season, good size at beginning but falls off rapidly; a good shipper.

CHARLES (per.) (Parsons Beauty \times Francisca).—Orig. C.E.F., Ottawa. Characterized by its heavy yield and ability to ripen all its fruits. Light and not brilliant in colour; pale salmon flesh; good quality; plants vigorous; an excellent runner producer; not firm enough for long shipment, but is being used by several large growers for local markets.

CLARE (imp.) (Willard open pollinated).—Orig. C.E.F., Ottawa. A dark coloured, dark fleshed berry, wedge conic in shape, firm fleshed, medium quality; a fairly good shipper. The plants medium in vigour, low growing with fruit rather too close to the ground. Has done well in several localities.

CLARIBEL (imp.) (Ettersburg 121 \times Cassandra).—Orig. C.E.F., Ottawa. An extremely firm berry for shipping, large, conic wedge shaped, very attractive with shiny, deep scarlet colour; flesh scarlet, moderately juicy, rather tough; not high in quality; very late in season; plants are vigorous if well fed, otherwise inclined to be low growing; fruit on short stalks; worthy of extended trial where a good late shipper is desired.

CULVER (per.) (Marshall \times Howard 17).—Orig. New York State Agr. Exp. Sta., Geneva, N.Y. An outstanding variety at Ottawa. Dark coloured fruit, dark fleshed, good quality, moderately firm. A midseason sort. Plants vigorous, dark green foliage and good runner makers.

DICK (per.) (Superb \times Westney).—Orig. C.E.F., Ottawa. Has not proved up at Ottawa, but has proved promising at several centres because of its vigour, good runner production, high yield and earliness. Fruit is bright and attractive, medium in size, fair quality, too soft for distant shipment.

DORSETT (per.) (Royal Sovereign \times Howard 17).—Orig. by U.S.D.A. A very attractive, bright scarlet berry with salmon coloured flesh, juicy, of very good quality, firm and a good shipper. Plants very vigorous and prolific runner makers. Drops in size very rapidly, probably due to too much competition when planted the regulation distances. Should be given a thorough trial.

FAIRFAX (per.) (Parentage unknown).—Orig. by U.S.D.A. Rather dark coloured but quite attractive, conic to wedge conic in shape, very fine fleshed, a good shipper, almost sweet in flavour and of excellent quality. Very vigorous and a prolific runner maker. Has same fault as Dorsett in losing size. Recommended for trial.

HOWE (per.) (Red Sugar \times Howard 17) \times (Willard \times Santiago de Chile). Dark coloured, very attractive with pink flesh of firm meaty texture. Flavour mild, sub-acid and pleasant; firm and a very good shipper; medium early in season; plants very vigorous with healthy, dark green leaves and very stout and erect fruit stalks. A very good runner maker. Holds up in size throughout the season with a good yield. Recommended for extended trial.

JIM (per.) (Willard open pollinated). Orig. C.E.F., Ottawa. Large sized fruit, conic in shape with a large calyx; pale fleshed, juicy and meaty in texture; good quality, although only fairly firm, holds up well in long shipments; a good early berry for local use; plants vigorous and healthy.

JOHN (per.) (Willard open pollinated).—Orig. C.E.F., Ottawa. A scarlet coloured, attractive berry, conic in shape; flesh bright red and firm, meaty in texture; quality good and a fairly good shipper, medium early in season; plants vigorous, rather low growing and good runner makers. Holds its size well throughout season.

MARGARET (per.) (Bederwood \times Pocomoke).—Orig. C.E.F., Ottawa. A very dark coloured fruit that is recommended for trial on the prairies. The berries are medium in size, dark fleshed and of fair quality. Appears to be quite drought resistant.

LOUISE (imp.) (Ettersburg 80, selfed).—Orig. C.E.F., Ottawa. A very late season variety and outstanding for flavour, quality and yield. Fruit medium to large, bright scarlet with pink flesh which is very firm and meaty in texture. A most excellent shipper. Plants vigorous and healthy with stout, erect fruit stalks. A good runner maker. Has been grown in very severe districts. Recommended where a late berry of high quality and good shipping quality is desired.

RALPH (per.) (Superb \times Westney).—Orig. C.E.F., Ottawa. A very early fruiting variety that consistently yields a large crop of firm, medium sized, conical shaped berries of good quality. Appears to be highly drought resistant and while not very large, holds its size well to the end of the season. Not particularly firm and hulls very easily, but ships surprisingly well. Holds top place for the frozen fruit trade.

ROBERT (per.) (Willard open pollinated).—Orig. C.E.F., Ottawa. A very attractive fruit not unlike Dunlap. Quite early in season and a fair shipper if not overripe. Plants vigorous, healthy and good runner makers. Recommended for trial on the Prairies.

SIMCOE (imp.) (Red Sugar \times Howard 17) \times (Delecto \times Cassandra).—Orig. C.E.F., Ottawa. Large sized, conic shaped, bright coloured berries with a large calyx and slight neck. Flesh salmon coloured, good quality. Berries are firm and ship well. Plants outstandingly vigorous with tall, erect fruit stalks. A midseason variety that is a poor yielder.

TUPPER (imp.) (Ettersburg 214 \times Cassandra).—Orig. C.E.F., Ottawa. A particularly attractive variety but not firm enough for distant shipping. Of value for local trade on account of its attractiveness, uniformity, yield and excellent plant characters.

WRIGHT (per.) (Portia \times Ettersburg 512) \times (Santiago de Chile selfed).—Orig. C.E.F., Ottawa. A variety of distinctly different type, more closely resembling some of the European varieties. Fruit medium large in size, very bright in colour with large surface seeds and a medium sized calyx which comes away readily. Flavour is sweet and aromatic; quality very good and very firm, making an excellent shipper. Foliage dark green and leathery. Plants low growing, producing only a fair number of runners. Should either be grown on the hill system or planted closer than regulation distance.

KING (per.) (Delecto \times Cassandra selfed).—Orig. C.E.F., Ottawa. A dark coloured variety that has proved very useful for jam and canning purposes. Prominently necked, good sized fruit. The quality is good and the fruit firm enough to be a good shipper. A vigorous grower that retains its size very well.

MACKENZIE (per.) (Excelsior \times Premier).—Orig. C.E.F., Ottawa. Much like Premier in appearance and season and at Ottawa is distinctly better than that variety. Fruit large, dark coloured and firm; flesh dark with fair quality. A good plant maker and heavy yielder. Promising for trial where an early variety is desired.

COMMON STRAWBERRY INSECTS AND THEIR CONTROL

By WILLIAM A. ROSS, Dominion Entomological Laboratory,
Vineland Station, Ont.

(a) Injury to Blossom Buds

1. Weevils cut blossom stems causing the buds to wilt, drop off, or hang by a thread.....STRAWBERRY WEEVIL

(b) Injury to Leaves

2. Small beetles eat out holes in leaves giving the foliage a "shot-holed" appearance.....STRAWBERRY LEAF BEETLE
3. Greenish or brownish caterpillars fold the leaves over, often across the midrib, and feed within the shelters thus formed.....
.....STRAWBERRY LEAF ROLLER
4. Foliage chewed during night by smooth, stout caterpillars which hide in the soil by day.....CUTWORMS

(c) Injury to Roots

5. Large whitish grubs, with six distinct legs, eat off the roots and kill the plants.....WHITE GRUBS
6. Small, whitish grubs, with no distinct legs, feed on roots and weaken or kill the plants.....STRAWBERRY ROOT WEEVIL

(d) Injury to Collar

7. Plants cut off near ground level by smooth, stout caterpillars which hide in the soil by day.....CUTWORMS

THE STRAWBERRY WEEVIL

(Anthonomus signatus Say)

Occasionally the yield of strawberry plantations is very seriously reduced by the strawberry weevil—a small reddish brown or blackish snout beetle about $\frac{1}{10}$ -inch long, which cuts off the blossom buds.

Habits and Life-History.—The adult weevils hibernate under rubbish, particularly in woodlots and waste land adjoining strawberry fields. In spring the insects leave their winter quarters and appear on the strawberry plants about the time the first buds are forming. The female weevil, by means of her slender snout, punctures the blossom buds and deposits oval, whitish eggs singly, in the interior of the buds among the stamens. After depositing an egg the female then crawls down the blossom stem and girdles it so that the bud either falls immediately or is left hanging for a few days by a mere thread. On hot, still days the weevils are most active and can then be readily seen working on the buds. When it is cool, they usually hide and are difficult to locate. Within the severed buds the whitish grubs, which hatch from the eggs, feed at first on the pollen and later on other interior parts. They become mature in about a month, pupate and emerge from the buds as adults during July. The new adults feed for a short time on the pollen of various flowers and then in midsummer they seek their hibernating quarters. There is only one generation a year.

Control.—(1) Clean farming: In combating this insect it is very important to secure as clean conditions as possible in and around the strawberry plantations. This involves the destruction of weeds, rubbish, and anything which may afford the weevil winter protection. It is also advisable not to plant the strawberries near bush or waste land.

(2) Dusting: Protection from the weevil may be obtained by coating the plants with a dust composed of sulphur and lead arsenate, either a 90-10 or

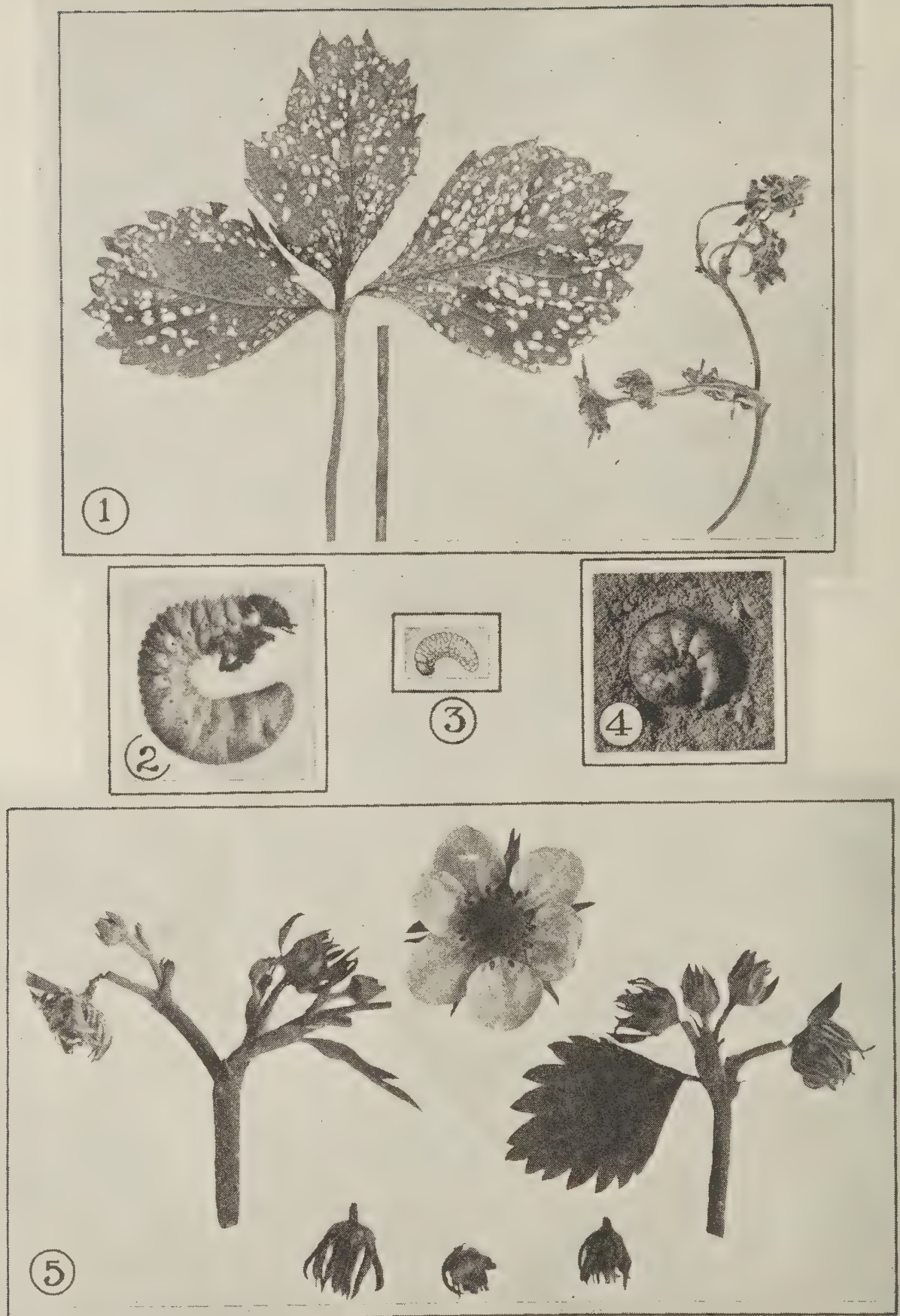


FIG. 23.—1. Work of strawberry leaf beetle. 2. White grub. 3. Strawberry root weevil. 4. Cutworm. 5. Work of strawberry weevil.

85-15 mixture. Ordinarily two applications are sufficient, the first when weevil feeding begins, and the second immediately after a washing rain, or seven days later than the first application, if the weather is dry. It is essential that all the buds be kept coated with the dust until they open. The only satisfactory way of applying the dust is with a power duster or a good hand-blower.

THE STRAWBERRY LEAF BEETLE

(*Paria canella* Fab.)

In spring and autumn, strawberry plants are occasionally attacked by a dark brown or black shiny, oval-shaped beetle about $\frac{1}{8}$ inch long—the strawberry leaf beetle—which eats out holes in the leaves, giving them a lacework effect. In addition to the strawberry, this insect also feeds on raspberry, blackberry and some other plants.

Habits and Life-history.—The beetles hibernate among old leaves, straw, or trash, and as soon as growth commences in the spring the insects feed voraciously on the leaves. They lay their eggs in the soil close to the crowns of the plants, and on the underside of dead leaves lying around the plants. The very small grubs hatching out from these eggs burrow a little way into the soil and feed on the tiny rootlets of the strawberry plant which must further weaken the plant. When full grown the grubs are about $\frac{1}{6}$ inch long. They then pupate in the soil and the new adult beetles emerge from about the end of July up to September. After feeding for a while, the beetles go into their winter quarters.

Control.—As soon as the beetles are found feeding on the leaves, spray thoroughly with lead arsenate 2 pounds, or calcium arsenate $1\frac{1}{2}$ pounds, in 40 gallons of a 4-6-40 Bordeaux mixture.

THE STRAWBERRY LEAF ROLLER

(*Ancyliis comptana* Frohl.)

This insect has not been very troublesome in Canada, although occasionally it has effected serious injury. The caterpillars fold the leaves, fastening the edges with fine silk threads, and feed within the shelters thus formed.

Habits and Life-History.—The insect passes the winter as larvae and pupae in trash and in the folded leaves. In spring small inconspicuous moths, not quite $\frac{3}{8}$ inch long, emerge from the overwintering pupae, and the overwintering larvae soon pupate and yield more moths. The moths do not fly readily in the day time, but where present in large numbers, may be disturbed by brushing a stick over the plants when they will come out in a small cloud and soon settle again. Eggs are laid by the moths singly, on the upper and lower surface of the leaves, and are quite difficult to see as they are flattened against the surface. The caterpillars hatching therefrom feed on the leaf tissue and soon begin to tie the leaves together usually commencing by bridging across the hollow formed by the midrib on the upper surface of the leaf with silk. The silk strands are increased and tightened until the halves of the leaflet come together. In this shelter the larva is well protected. When full grown the caterpillars are about $\frac{1}{2}$ -inch long, greenish or brownish, and very active when disturbed. These pupate and a new brood of moths appears in late summer to repeat the process.

Control.—If the presence of this insect is not detected until the leaves are folded, as is usually the case, the caterpillars are so well protected from spray materials that nothing can be done until the crop is harvested. As soon as the crop is off, run the mower over the rows and immediately rake the leaves between the rows and burn them. The following spring spray the plants just before the blossoms open with lead arsenate 2 pounds, or calcium arsenate $1\frac{1}{2}$

pounds in 40 gallons of 4-6-40 Bordeaux mixture. Where the old plantation is not kept for another year, it is best to plough it under as soon as the crop is off in order to prevent the insects from infesting the new plantation.

The new plantation can be protected by removing and crushing folded leaves at time of planting and by keeping the leaves coated with spray until the old plantation has been ploughed down or mowed off and the leaves burnt. Spray as soon as the plants are set out, with the same mixture advised for the old plantation, and repeat when the coating is removed by weathering or when new unprotected growth appears. Protection by spray must be given until neighbouring sources of infestation have been removed or treated.

CUTWORMS

Several species of cutworms may cause much damage in strawberry plantations by cutting off the new plants and by chewing the foliage of older plants. In general, cutworms are similar in appearance, being smooth, cylindrical caterpillars about 1 inch or more in length, and in colour some dull shade similar to the ground. They feed during the night and hide in the soil during the day. Injury by cutworms usually ceases before the end of June.

Control.—The following poisoned bait will control cutworms:—

Bran..	25 lb
Paris green..	½ “
Molasses..	1 quart
Water..	about 2½ gallons

The dry and liquid ingredients should be mixed separately and then brought together in a tub and the whole thoroughly stirred. Scatter the bait thinly on the ground after sundown, along the rows where the cutworms are present. It is important that this should be done in the evening and only following a warm day.

WHITE GRUBS

(Phyllophaga Spp.)

White grubs—the larvae of the well-known June beetles—are the large, stout, greyish-white grubs, usually curved in a half circle when at rest, which are quite frequently found feeding on the roots of strawberries. They either kill or seriously weaken the plants, and are usually most destructive where strawberries are planted after sod.

Life-history and Habits.—In May and June the beetles are commonly found flying about in the evening and at night, particularly around trees, upon the leaves of which they feed. They lay their eggs in soil covered with vegetation, chiefly in grass land. The tiny grubs hatching from the eggs feed on the roots of plants until late autumn when they burrow deeper in the soil and remain dormant until the spring of the following year. With the warmer weather, they come nearer the surface again and continue their feeding throughout the season. The next year they pupate in earthen cells during late summer, and later transform to the adult or beetle stage. The adult remains in the pupal cell until the following May and June when it comes out of the ground to fly around as the familiar June “bug.”

Control.—White grub injury may be largely prevented by growing hoed crops one or preferably two years prior to planting the strawberries; by not setting out the plants in land broken up from timothy or pasture land; and by thoroughly disking the soil some four or five times before planting. If strawberries are planted in soil free from grubs, and the plantation is kept clean, these insects will cause little or no injury. Where white grubs are discovered in the plantation after it has been set out, they should be dug out and killed, where this is practicable.

THE STRAWBERRY ROOT WEEVIL

(Brachyrhinus ovatus L.)

The strawberry root weevil, while widely distributed in Canada, ranks as a serious pest of the strawberry only in British Columbia. The adult—a small dark beetle, egg-shaped in general outline, and about $\frac{1}{4}$ inch long—nibbles strawberry leaves, but the all-important injury is caused by the small, white, legless grubs feeding on the roots and in this way weakening or killing the plants.

Life-history and Habits.—The weevil passes the winter in two stages: (1) as adults hibernating in among the strawberry plants and in almost any sheltered spot, and (2) as immature grubs in the soil around the roots of the strawberry plants. In spring the grubs commence feeding again and soon reach maturity when they pupate in the soil and transform to adults towards the end of May. These new beetles, together with those which have overwintered, may aggregate an enormous number of weevils. Every weevil is a female capable of laying fertile eggs. The eggs are deposited in the soil, usually near the crown of the strawberry plants and the larvae or grubs hatching therefrom feed upon the fine rootlets. A few of the grubs reach maturity in autumn and pupate in the soil. Adults from these emerge in late autumn and winter over. The majority of the larvae, however, remain dormant through the winter and mature the following spring.

Control.—The strawberry root weevil may be controlled by a combination of cultural measures and the use of poisoned bait. Successive plantings of strawberries should never be grown on the same land, but a suitable rotation of crops should be adopted so that the berries follow some crop, such as potatoes, which is not favoured by the weevil. Planting after clover sod is not advisable where the weevil has been troublesome, unless the land is thoroughly baited when the plants are set out and again in June, as described below.

A badly infested plantation should not be ploughed under immediately after picking, as this would cause the insects to move to nearby plantings, but it should be left, together with any mulch, until the end of August or early September when the plants should be lifted and burned. The field should then be ploughed and kept thoroughly cultivated for a month or six weeks to destroy the young larvae, after which a late crop may be planted if desired.

Poisoned Bait.—Where a field has become infested the only satisfactory method of control is the use of a poisoned bait made according to the following formula:

50 pound raisins	5 pound sodium fluosilicate (or
50 pound shorts	7 pound sodium fluoride*).

Soak the raisins in five quarts of water from six to twelve hours, or until they are moist. Mix the dry shorts and sodium fluosilicate thoroughly together, then add the raisins from which the water has been drained and again mix. The bait should then be put through a butcher's meat mincer, which is set to cut coarsely, to form a slightly moist, crumbly mash.

Two applications should be made, the first in early spring and the second when the new generation of adult weevils appears, which in British Columbia is generally from the middle to the end of June. In applying the bait, drop about a tablespoonful of it in the centre of each plant and do not scatter it about the plants. The application should be made in dry, warm weather if possible. About 100 pounds of bait are required per acre. Spoiled or second grade raisins are quite satisfactory and may often be purchased cheaply.

As sodium fluosilicate is poisonous, it should be used with caution, care being taken not to inhale the dust.

*The less valuable sodium fluoride should be used only where sodium fluosilicate cannot be obtained.

COMMON STRAWBERRY DISEASES AND THEIR CONTROL

by G. H. BERKELEY, Senior Pathologist-in-Charge, Dominion
Laboratory of Plant Pathology, St. Catharines, Ont.

LEAF SPOT

This is the most widespread and best known disease of the strawberry.

This disease is recognized at first by small reddish or purplish spots which, as they increase in size, become paler in the centre until finally the centre is grey or almost white. A fully matured spot has a white centre surrounded by a distinct purplish border, which ultimately merges into the green of the healthy leaf. The spots are scattered irregularly over the leaf-surface and when numerous may kill not only the leaf but in extreme cases the plant as well.

The use of varieties that are known to show some resistance to this disease is a possible means of prevention. In this connection it must be pointed out that no variety is actually immune, and that even a seemingly resistant variety may be affected by leaf spot in some seasons, and in some districts.

Control.—Where it is the practice to crop a plantation only once or twice, leaf spot is as a rule, not troublesome, and under such conditions of cultivation, spraying is often unnecessary. On the other hand where plantations are cropped three or more times (not the usual practice to-day) leaf spot may be expected to become prevalent and spraying with Bordeaux 4-4-40 as soon as growth is well started in the spring may be necessary. This should be followed by two or more applications with the same material so as to keep the leaves covered with Bordeaux mixture.

In the setting of a new plantation, do not use plants severely spotted with leaf spot but use only good, strong, healthy plants, removing any leaves that may be "spotted." Mowing off and burning old leaves also helps in checking leaf spot.

LEAF SCORCH

Scorch is also a disease of the foliage but is not so general in distribution as leaf spot. In its early stages it may easily be mistaken for leaf spot since the spots in both cases are purplish in colour although the scorch blotch is more irregular in outline. Later, as the season advances, these spots enlarge and coalesce. In severe cases the entire leaf may become purplish in colour. Soon the blotches become dry, and dark fruiting bodies of the fungus appear. As the disease progresses the leaves take on a dry, burned appearance. In cases of severe infection the plants may be killed or so weakened as to be useless.

Leaf scorch is seldom very prevalent the first year of a new plantation.

Control.—The same as for leaf spot; clean cultivation, destruction of old foliage, and spraying with Bordeaux mixture.

POWDERY MILDEW

Mildew has long been recognized as a serious disease of the strawberry. The earliest and most conspicuous symptom of the disease is the curling of the leaves upward so that the lower surface is exposed. A close examination of the lower surface will show the white, mildewy growth of the fungus which causes this disease. In severe cases the leaves become dry and the plant may be totally destroyed. If the attack of the mildew occurs before picking time the loss in yield may be considerable, amounting to almost a complete failure.

The following varieties exhibit considerable resistance to mildew in most seasons: William Belt, Parsons Beauty, Portia, Glen Mary and Senator Dunlap.

Control.—With mildew, as with leaf spot and leaf scorch, it has been found that careful sanitary measures usually prove sufficient protection. The use of sulphur dust has given good results. The sulphur may be applied by using a dusting machine, by shaking through a sieve, or by shaking a cotton bag filled with the sulphur over the rows to be treated. The first application should be given upon the first indication of mildew, which may appear suddenly, especially if the rows are heavily matted and the plants have made good growth. The number of additional “dustings” will depend largely upon weather conditions. It is generally necessary to make at least three applications.

Recently the New York (Geneva) Agricultural Experiment Station has demonstrated that mildew may be practically eliminated even during seasons of severe infection, by four applications of 85-15 lime-copper dust. The first application was made as the first buds were expanding in the cluster, followed by additional applications at twelve-day intervals.

GREY MOULD

This is a fruit disease and is found in some seasons to affect not only ripe fruit on the plant but partially matured fruit as well. It also causes loss of fruit in transit. In some years, considerable loss has been sustained in plantations in the Niagara Peninsula due to early attacks of this fungus on green fruit, which results in the destruction of the fruit before it reaches maturity.

The disease is first apparent as a brown discoloration, which soon spreads throughout the berry until it is wholly rotten. Later the fruit dries out and is then soon covered with the fine grey powdery growth of the causal fungus.

The fungus develops best in moist, still air and thus is likely to be most destructive in old, weedy plantations, or in those poorly drained following periods of heavy rainfall.

Control.—Clean cultivation, freedom from weeds, good drainage, and sanitary measures are essentials in control. All berries showing signs of fruit rot should be culled out during picking so as not to contaminate sound fruit in transit. Applications of Bordeaux mixture as outlined for leaf spot will also be of assistance in checking this trouble, but under Ontario conditions this is not generally necessary.

LEAK

The most common and destructive rot of strawberries in transit and in storage is known as “leak,” and is caused by the common bread mould. It rots the ripe fruit rapidly and breaks down the tissues with a resulting loss of juice. It is not uncommon for the juice to drip from boxes of badly infected fruit.

The leak mould gains entrance through wounds and therefore sound fruit does not “leak”. It is accordingly good practice to pick and pack fruit with the greatest care and to discard any soft fruit. The leak fungus grows very slowly at temperatures below 50° F. Therefore, if fruit is sound and is held at a low temperature the possibility of leak and fruit rots is diminished. Careful handling in picking, sorting, packing, and loading is absolutely essential if severe loss from rot is to be avoided.

STRAWBERRY ROOT-ROT

The leaves and petioles of plants affected with root-rot, are greatly reduced in size and often in number, though otherwise they may appear normal, with the exception that the leaves generally become brown or slightly yellow in

colour, particularly if growing in heavy, wet soil. Since root-rot plants are generally stunted, they have a "flat" appearance.



FIG. 24.—Strawberry root-rot: dwarfed and flat plant in centre attacked by root-rot.

When plants are severely affected, the foliage wilts and the plants ultimately die. Wilting is particularly prevalent around fruiting time. The roots of root-rot plants show (i) a noticeable lack of fibrous roots, (ii) black lesions on otherwise healthy roots, and (iii) blackened and dead roots.



FIG. 25.—Strawberry root-rot. Note "black lesions" and dead roots on young runner plant.

Cause.—This disease is not caused by a single organism, nor is it influenced by a single set of conditions. Rather it is considered to be the result of the attack of several soil organisms, acting singly, or in various combinations, in which such environmental factors as temperature, moisture, drainage, etc., play an important role.

Control.—(1) Secure healthy stock from plantations free from root-rot.

(2) Carefully grade the stock before planting, discarding all plants with black roots.

(3) If possible, choose a well-drained site that has not grown strawberries for many years.

(4) Practise rotation of crops. Plan your strawberry plantings so that three to four years will intervene before strawberries are again planted in the same location.

JUNE YELLOWS

This trouble has been found on several varieties and in many different sections of Canada. The symptoms first appear in early spring as a yellowing of the unfolding leaves. Close examination of affected plants shows a yellowish to green leaf mottling, accompanied in some varieties by a puckering and curling of the leaf tissue.

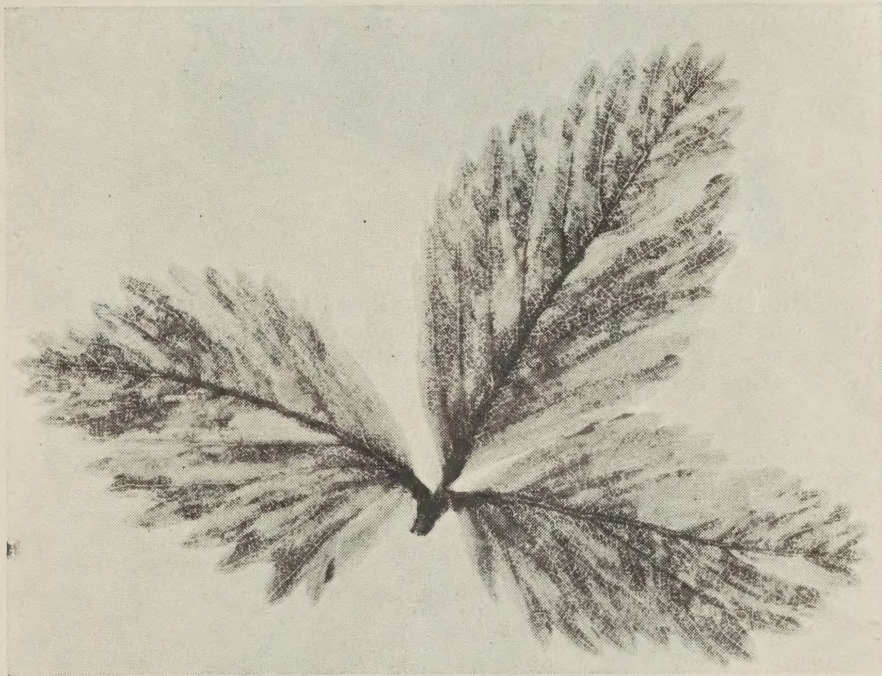


FIG. 26.—June Yellows. Note the mottled condition of the leaf. Under field conditions, in the spring, such leaves are yellow.

A peculiar characteristic of this trouble is that the yellow coloration gradually disappears with the approach of hot weather, so that by mid-July an affected plantation may appear to be healthy. In reality, however, the trouble has not disappeared since “yellows” again becomes prominent the following spring. Varieties which have been found affected in Ontario are, Eaton, Van Dyke, Waite’s Everbearer, Grand Prize, Minnesota No. 3, Forward, Premier

(Howard 17), Senator Dunlap and Blakemore. In the latter variety the symptoms may persist throughout most of the growing season.

Cause.—Though the cause of this trouble is not definitely known, it is now generally considered to be of genetic origin, i.e., the result of cross-breeding.

Control.—Avoid the use of stock from affected plantations.

XANTHOSIS OR YELLOW-EDGE

Though this disease has been observed in only a few plantations, grafting experiments at St. Catharines have indicated that Premier, Glen Mary and Parsons Beauty varieties may be affected without giving any outward indications. Therefore there is a possibility that this trouble may be more widespread than is at present realized. Xanthosis or Yellow-edge causes a dwarfing and “cupping” of the inner leaves, accompanied by a yellow-edging of the foliage, hence the name.



FIG. 27.—Xanthosis. Note small, yellow-edged leaves in centre, while the older leaves are more or less normal as compared with healthy plant (Fig. 28) of same variety.



FIG. 28.—Healthy Premier plant.

Once a plant becomes affected it never recovers (though for a time the symptoms may be masked) and all its progeny is likewise diseased. In some sections of the U.S.A. and in England this is a very important and serious trouble. However in Ontario it has been observed in only a few plantations and so far as is known it is of minor importance here.

Cause.—This is a “virus” disease and is spread by the strawberry aphid.

Control.—(1) Rogue all infected plants as soon as observed.

(2) Do not take planting stock from an affected plantation.

